# FASTCAM Mini R5-4K

**FASTCAM MINI R5-4K**

**9.4-megapixel CMOS Image Sensor:**
4096 x 2304 pixels at 1,250fps
2048 x 2048 pixels at 2,880fps
1920 x 1080 pixels at 5,280fps

**Maximum Frame Rate:**
200,000fps

**Class Leading Light Sensitivity:**
ISO 4,000 monochrome
ISO 800 color

**Global Electronic Shutter:**
2µs independent of frame rate

**Dynamic Range (ADC):**
12-bit monochrome
36-bit color

**Compact and Lightweight:**
120mm (H) x 120mm (W) x 94.4mm (D)
4.72″ (H) x 4.72″ (W) x 3.71″ (D)
Weight: 2.1kg (4.63lbs.)

**Internal Recording Memory:**
16GB, 32GB, 64GB

**Fast 10-Gigabit Ethernet Interface:**
Provides camera control and high-speed image download to standard PC

**Fan Stop Function:**
Remotely switch off cooling fans to eliminate vibration when recording at high magnifications

**High-G Rated:**
Suitable for application in high-G environments.
Operation tested to 100G, 10ms, 6-axes

## COMPACT AND VERSATILE HIGH PERFORMANCE 4K-UHD CAMERA SYSTEM

This new generation of the popular FASTCAM Mini series with a proprietary 4K/ UHD sensor is ideally suited for applications where observation of a large spatial area without loss of image quality is required - applications such as automotive safety testing (car-to-car, pedestrian testing, barrier/ roll-over testing and curtain airbag), fluid dynamics (PIV, microfluidics) material testing (DIC, drop testing) are some of the main applications for this product.

With the FASTCAM MINI R5-4K camera, users can enjoy 12-bit image recording rates of up to 1,250fps at 4K resolution, with impressive shutter speeds that go as low as 2µs. For even higher frame rates, the camera offers recording rates of up to 200,000fps at lower image resolutions. The FASTCAM MINI R5-4K is compact, rugged, lightweight, and provides the best light sensitivity and image quality – truly setting it apart from other cameras in its class.

Key features of the FASTCAM MINI R5-4K include an internal mechanical shutter that allows for remote system calibration, a high-performance 10-Gigabit Ethernet interface for seamless camera control and fast image download, memory segmentation that enables recording into one memory partition while downloading from another, and compatibility with various industry-standard lens formats such as Nikon G-Type, C-mount, and Canon EF lenses.

Additionally, the design of the FASTCAM MINI R5-4K boasts a "sealed body" construction to safeguard sensitive electronics against dust and corrosive particles. This ensures optimal performance and longevity for the camera.

Intuitive and feature rich Photron FASTCAM Viewer (PFV) software is included with each FASTCAM MINI R5-4K camera. Also included is a Photron Device Control SDK that allows integration of the camera with user-specific software, and libraries for controlling the camera within a MATLAB® or LabView environment.

In conclusion, the FASTCAM MINI R5-4K camera is unrivaled in its flexibility and versatility due to its advanced technology and intelligent design. It delivers exceptional light sensitivity, image quality, and functionality across diverse applications.

**Light Sensitivity:**

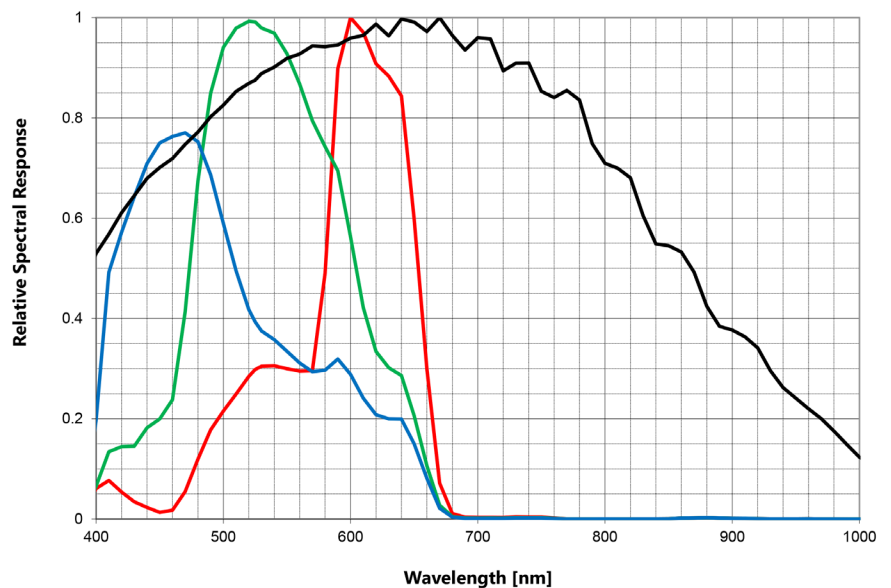| FASTCAM MINI R5-4K | |
| --- | --- |
| Monochrome models | ISO 4,000 |
| Color models | ISO 800 |

Image Sensor:
The FASTCAM MINI R5-4K camera uses an advanced CMOS image sensor optimized for light sensitivity and high image quality that is unique to Photron.

A 6.5-micron pixel pitch gives a sensor size at full image resolution of 26.62 x 14.98mm (diagonal 30.55mm).

Lenses designed for both FX (35mm full frame) and also Nikon DX (digital SLR) formats are compatible with the FASTCAM MINI R5-4K at UHD-4K resolution.

| | |
| --- | --- |
| Sensor Type | Proprietary Design Advanced CMOS |
| Maximum Resolution (pixels) | 4096 x 2304 pixels |
| Sensor Size / Diagonal | 26.62 x 14.98mm / 30.55mm |
| Pixel Size (microns) | 6.5µm x 6.5µm |
| Quantum Efficiency | TBD |
| Fill Factor | TBD |
| Color Matrix | Bayer CFA (single sensor) |
| Light Sensitivity | ISO 4,000 monochrome<br>ISO 800 color |
| Shutter | Global Electronic Shutter 2.0µs independent of frame rate |

**FASTCAM MINI R5 Relative Spectral Response Curves - Monochrome and Color**

**Camera Performance Specifications**

| Model | FASTCAM MINI R5-4K |
|---|---|
| Full Frame Performance | 1,250fps<br>4096 x 2304 pixels |
| Maximum Frame Rate | 200,000fps (2048 x 8 pixels) |
| Minimum Exposure Time | Global electronic shutter to 2.0μs selectable independent of frame rate |
| Ruggedized Mechanical Calibration Shutter | Standard feature |
| Dynamic Range (ADC) | 12-bit monochrome / 36-bit color |
| Memory Capacity Options | 16GB, 32GB, 64GB |
| Memory Partitions | Up to 128 memory segments |
| Region of Interest | Selectable in steps of 128 pixels (horizontal) x 8 pixels (vertical) |
| Trigger Inputs | Selectable +/- TTL 5V and switch input (may be configured NO or NC) |
| Trigger Delay | Programmable on selected input / output triggers: 100ns resolution |
| Input / Output | Input: Trigger (TTL/Switch), sync, ready, event, IRIG<br>Output: trigger, sync, ready, rec, exposure |
| Trigger Modes | Manual, random reset, random manual |
| Time Code Input | IRIG-B (selectable at beginning or end of frame exposure) |
| External Sync | +/- TTL 5Vp-p Variable frequency sync |
| Camera Control Interface | High-speed 1/10 Gigabit Ethernet |
| Image Data Display | Frame rate, shutter speed, trigger mode, date/time, status, real time / IRIG time, frame count, resolution |
| Saved Image Formats | BMP, TIFF, JPEG, PNG, RAWW, MRAW, AVI, MOV, GRAW |
| Supported OS | Microsoft Windows operating system including: 8.1, 10, 11 (32/64-bit) |

**High-Speed Gigabit Ethernet Interface:**
The FASTCAM MINI R5-4K camera is with a high-speed 10-Gigabit Ethernet Interface to provide reliable camera control and fast download of image data.

**Dedicated I/O:**
A dedicated BNC connection for a contact closure hardware trigger input supporting NO, NC opertion is provided. In addition, two programmable inputs and two programmable output channels provide direct connection for common tasks such as synchronization of multiple cameras and operation in conjunction with Data Acquisition (DAQ) hardware.

**Ruggedized Mechanical Calibration Shutter:**
The ruggedized mechanical shutter is fitted as standard to FASTCAM MINI R5-4K camera allows sensor black balance calibration to be carried out remotely from the system control software.

**Optional Canon EF Lens Mount:**
In addition to the standard C-mount and Nikon G type lens adapters, the FASTAM MINI supports an optional Canon EF lens adapter which, through Photron FASTCAM Viewer (PFV), not only enables remote operation of lens focus and aperture but also adds Auto-Focus capability.

## Camera Operation Features

| | |
|---|---|
| Frame Synchronization | Accurate frame synchronization with other cameras and with external and unstable frequencies. |
| Memory Partitions | Up to 128 memory segments. |
| Low Light Mode | Operation at minimum frame rate with separately adjustable shutter time to allow easy camera set-up and focus in ambient lighting. |
| IRIG Phase Lock | Enables multiple cameras to be synchronized together with other instrumentation equipment or to a master external time source. |
| Internal Time Delay Generator | Allows programmable delays to be set on input and output triggers; 100ns resolution. |
| Event Markers | Up to ten user-entered event markers to define specific events within the recorded image sequence . |
| Download While Recording | The FASTCAM MINI R5-4K camera supports Partition Recording Mode, allowing image data captured in one memory partition to be downloaded while at the same time recording into another partition. |
| Automatic Download | The system can be set to automatically download image data to the control PC and, when download is complete to re-arm in readiness for the next trigger with automatically incremented file names. |
| Software Binning | Virtual pixel binning (2x2, 4x4 etc.) allows increased light sensitivity with reduced image resolution without changing camera field of view. |

## Operation Software Features

| | |
|---|---|
| Image Calibration | 2D image calibration allows the measurement of distance and angle from the image. A calibration grid overlay can be superimposed on the image. |
| Image Overlay | A stored reference image may be overlaid on the live image to allow accurate camera positioning to achieve the same view as a previous test. |
| Import of Multiple Image Sequences | Multiple image sequences can be loaded and simultaneously replayed. Timing of image sequences can be adjusted to create a common time reference. Time based synchronization allows images captured at different frame rates to be synchronized. |
| High Dynamic Range Mode | Making use of the full sensor dynamic range, HDR mode allows enhanced detail in both light and dark areas of an image to be displayed simultaneously. |
| Background Subtraction | In order to highlight subtle changes in an image, Background Subtraction allows a reference image to be subtracted from a recorded sequence. Details including propagation of shock waves and surface changes during impact can be visualized using the feature. |
| Line Profile | A line profile representing grey levels along a line drawn across any region of the image is displayed. In live mode the Line Profile can be used to ensure optimum image focus is achieved. |
| Histogram | A histogram displaying grey levels within a user-defined image area is displayed. In live mode the Histogram can be used to ensure that optimum exposure levels are set for the scene being recorded. |
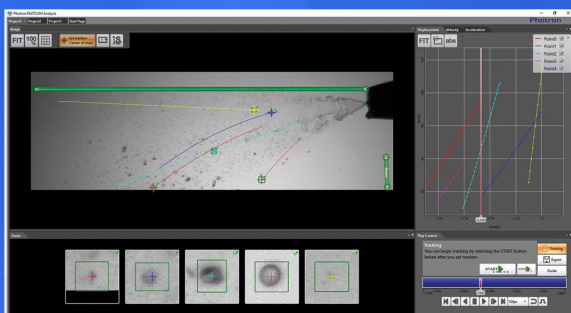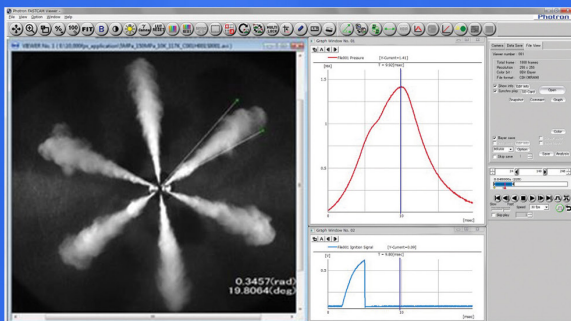
**Photron FASTCAM Viewer:**
Photron FASTCAM Viewer software (PFV) has been designed to provide an intuitive and feature rich user interface for the control of Photron high-speed cameras, data saving, image replay and simple motion analysis. Advanced operation menus provide access to features for advanced camera operation and image enhancement. Tools are provided to allow image calibration and easy measurement of angles and distances from image data. Also included are a C++ SDK and wrappers for LabView and MATLAB ®.

An optional software plug-in module provides synchronization between Photron high-speed cameras and data acquired through National Instruments data acquisition systems. Synchronized data captured by the DAQ system provides waveform information which can be viewed alongside high-speed camera images.

**Photron FASTCAM Analysis:**
PFV software allows image sequences to be exported directly to optional Photron FASTCAM Analysis (PFA) Motion Analysis software. This entry level Motion Analysis software with an on screen 'step by step guide' function provides automated tracking of up to 5 points using feature or correlation tracking algorithms for the automated analysis of motion within an image sequence.

| FASTCAM MINI R5-4K | | | | |
|---|---|---|---|---|
| **Resolution** | **Maximum Frame Rate** | | | |
| **(h x v pixels)** | **MINI R5-4K** | **64GB** | **32GB** | **16GB** |
| 4096 x 2304 | 1,250 | 4,827 | 2,399 | 1,186 |
| 4096 x 1504 | 2,000 | 7,395 | 3,677 | 1,817 |
| 4096 x 1024 | 2,880 | 10,862 | 5,401 | 2,670 |
| 4096 x 512 | 5,500 | 21,725 | 10,803 | 5,341 |
| 4096 x 256 | 11,250 | 43,452 | 21,607 | 10,684 |
| 4096 x 128 | 20,000 | 86,906 | 43,215 | 21,370 |
| 4096 x 64 | 40,000 | 173,813 | 86,432 | 42,741 |
| 4096 x 8 | 158,400 | 1,390,516 | 691,465 | 341,940 |
| 2048 x 2048 | 2,880 | 10,862 | 5,401 | 2,670 |
| 2048 x 1024 | 5,500 | 21,725 | 10,803 | 5,341 |
| 2048 x 512 | 11,250 | 43,452 | 21,607 | 10,684 |
| 2048 x 256 | 20,000 | 86,906 | 43,215 | 21,370 |
| 2048 x 128 | 40,000 | 173,813 | 86,432 | 42,741 |
| 2048 x 64 | 72,000 | 347,628 | 172,865 | 85,484 |
| 2048 x 8 | 200,000 | 2,781,033 | 1,382,932 | 683,881 |
| 1920 x 1080 | 5,280 | 22,066 | 11,019 | 5,496 |
| 1024 x 1024 | 5,500 | 43,452 | 21,607 | 10,684 |
| 640 x 480 | 12,000 | 148,320 | 73,755 | 36,472 |
| 512 x 512 | 11,250 | 173,813 | 86,432 | 42,741 |

\* Specifications subject to change without notice.

**Variable Region of Interest:**
Region of Interest (ROI) or sub-windowing allows a user-specified portion of the sensor to be defined to capture images. By using a reduced portion of the image area, the frame rate at which images are recorded can be increased. The FASTCAM MINI R5-4K camera allows the ROI to be set in increments of 128 pixels horizontal and 8 pixels vertical.

**External Frame Synchronization:**
The FASTCAM MINI R5-4K camera can be fully synchronized with an external source to allow the timing of when each individual image is captured to be precisely referenced. The camera can be accurately synchronized to unstable frequencies allowing complex events such as combustion in rapidly accelerating or decelerating engines to be recorded and studied.

**Record During Download Operation:**
The FASTCAM MINI R5-4K camera recording memory can be divided into multiple active sections. The user can record an on-going event in one memory partition while at the same time downloading a previously recorded image sequence in order to improve workflow and optimize camera operation.

**Mechanical and Environmental Specifications**

| Mechanical | |
|---|---|
| Lens Mount | M42, F-mount (G-type lens compatible) and C-mount provided - Optional lens mounts available include Canon EF remote control mount |
| Camera Mountings | 3/8 - 16 UNC, 1/4 - 20 UNC & 4 x M6 (base and side), 2 x 1/4 - 20 UNC (top) |
| **External Dimensions** | |
| Camera Body (excluding protrusions) | 120mm (H) x 120mm (W) x 93mm (D) 4.72" (H) x 4.72" (W) x 3.66" (D) |
| **Weight** | |
| Camera Body | 2.1kg (4.63lbs) |
| **Environmental** | |
| Operating Temperature | -10 to 40C, 14˚ to 104˚F |
| Storage Temperature | -20 to 60C, -4˚ to 140˚F |
| Humidity | 85% or less (non-condensing) |
| Cooling | Internal fan cooling (fan-off mode supported) |
| Operational Shock | 100G, 11ms, 6-axes 1000 times/axis |
| **Power** | |
| AC Power (with supplied adapter) | 100 to 240V, 50 to 60Hz |
| DC Power (primary input) | 22 to 32V, 120VA |
| DC Power (battery input) | 22 to 32V, 120VA |

**Nikon G-Type Compatible Lens Mount:**
FASTCAM MINI R5-4K camera is equipped with an objective lens mount compatible with readily available Nikon G-type lenses. Controls provided within the lens mount allow the control of lens aperture on lenses without external iris control.

**Optional Canon EF Lens Mount:**
An optional lens mount supporting Canon EF lenses is available for remote control of lens aperture and focus including Auto-Focus capability through Photron PFV software.

**Operation Environments:**
The 'sealed body' design of FASTCAM MINI R5-4K camera ensures optimum air flow and prevents dust and corrosive particles from being ingested within the internal camera body where they can damage sensitive electronics. The fans may be disabled during recording for any vibration sensitive measurements.

The FASTCAM MINI R5-4K camera has been extensively tested to ensure operation for extended periods in ambient temperatures up to 40 degrees C.

Specifications subject to change without notice.